



Robbie Cundy High School Mathematics Sioux Center High School Rosenboom Machine and Tool

Part I: General Overview of Business

- Rosenboom machine and tool was begun in 1974 by Lary and Viv Rosenboom. They began as a tool and die shop and currently manufacture custom hydraulic cylinders.
- Rosenboom is still family-owned and has over 800 employees across 3 manufacturing facilities.

Part II: Job Specifics

- Any of the CNC (Computer Numerical Control) machines need a person to program them for any given part they will produce. This person will develop a specific program that gives the machine the details--what tool to use, how fast to cut or drill, how deep to drill, etc--to make an accurate part.
- Math concepts are essential to making this process go smoothly!

Part III: Introduce the Problem

- A cavity block is a solid piece of steel or aluminum that attaches to one end of a hydraulic cylinder. It has many holes--cavities--drilled in it so that it can move hydraulic fluid to different locations in the cylinder.
- You are in charge of programming a machine to drill 2 holes in this cavity block. The first hole must be $\frac{7}{8}$ in. in diameter and 1.155 in. deep. The 2nd hole must be $\frac{1}{2}$ in. in diameter and 1.543 in. deep. The $\frac{7}{8}$ in. drill bit has an angle of 140 degrees. The $\frac{1}{2}$ in. drill bit has an angle of 142 degrees. (See picture on video)
- Precision is of the utmost importance.

Part IV: Background

- There are two defined depths for a drill hole--the *point depth* and the *full diameter depth*. This is because a drill bit is pointed. The outline shape of the drill bit is the shape of the hole it produces. (See picture on video)
- The depths given in the problem are *full diameter depths*. The CNC machine you are programming requires you to input the *point depth*. What *point depths* will you input into your CNC machine?
- A knowledge of Trigonometry is required for this task.

Part V: Business Solution

- Rosenboom used trigonometry to solve this problem too. They have solved it so much that they developed a formula: $Point\ depth = (.5 * bit\ diameter) / \tan(.5 * drill\ angle) + Full\ diameter\ depth$
- The CNC programmer took this formula one step further and programmed this formula into his TI-83 calculator. I plan to make this part an extension of my original problem.

Part VI: Student Solutions

- These possible solution methods will depend on how much exposure students have had with trigonometry. If students are very familiar with trigonometry, they will draw a diagram, draw the right triangles, and solve the problem using the tangent function. If a student is not familiar with trigonometry, he or she may try and find the missing side of the right triangle by using similar triangles (thinking it is almost a 30-60-90 triangle) or be stuck all together until they figure out how trigonometry can help.